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# The research of toucan crossing traffic light perception by road users

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**Abstract**

Cities are trying to improve bikers traveling conditions by adapting infrastructure to their needs, for example by expanding bike road network. This phenomenon leads to comfort improvement of bike usage and the growth of road safety level. On the other hand, it causes the increase of usage diversity of transport means, which are existing in transportation systems. Therefore readable, explicit and understandable information broadcasted by the traffic sings and road signals to all road users (drivers, pedestrians and bikers) is necessary to provide efficient functioning of transportation systems.

The current size of the pictograms located on the traffic light shield and its localization is determined by provisions of the regulations of the Minister of Infrastructure. According to current regulations it is allowed to connect two signals: for pedestrians and for bikers in one signaling device in special situations, which are dictated by location (shared crossing for pedestrians and bikers). Described solution allows to apply one support element and one two-compartment signal device. In opposite situations it is necessary to place two-compartment signals devices placed on one or two support elements. Size of pictograms used in pedestrian-bike signal devices is very different in comparison to exclusively pedestrian or bike signal devices.

Pedestrian symbol in toucan crossing signal device is about forty percent smaller in comparison to pictogram used in pedestrian signal device and bike template is thirty percent smaller than in normal bike signal device. toucan crossing devices displays two small symbols, which in some condition may not be read explicitly by individual road users. It might in fact cause risk situations.

The perception by participants of traffic signals is an essential aspect. Displayed signals should: provide unambiguous information (without leaving space for interpretation) and be understood by all users (regardless of age and visual problems. Misinterpretation the symbol or its inaccurate understanding can lead to dangerous situations (the intrusion of pedestrians on the

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road). That is why it is so important in the context of an aging population in Europe to examine the perception of the quality of the signals transmitted to traffic participants.
According to experts and road users, there is a problem of readable and explicit perception of the information provided by this traffic signal. This problem is an essential goal of the research presented in this article.
In order to examine the quality of toucan crossing signal perception by road users, an extensive research in Katowice city was conducted. During the research, division by age and condition of health (problem with vision) was considered. Length of measurement time allowed to analyze changes in daylight and their influence on signal perception by road users.
This paper is organized as follows: section one presents the legal conditions of toucan crossing signals usage, study of literature and examples of good practice. This is followed by next section, which describes the area on which analyze was conducted and elaborates on the research methodology. Afterwards, obtained results with detailed analysis are provided. Article ends with conclusions and discussion on currently used solution.


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*Keywords:* toucan crossing; perception of traffic light; pedestrian security

## 1. Introduction

The traffic can be divided into three basic groups of road users: the driver, pedestrian and cyclist. Pedestrians and cyclists move along separate elements of road infrastructure, such as: pavements and bike paths. A common solution to traffic organization is co-existence in the divisional borders (road surface marking, low curbs) of said road infrastructure. Combined with bicycle paths sidewalks at junctions create a common space for them to cross the road. In these places began to be used single-chamber signal light for pedestrians and cyclists. Another traditional solution is to use a separate signal light for pedestrians and cyclists on two outriggers.

Traffic for cyclists and pedestrians is an element of road infrastructure, which is used in many places around the world. The first information about pedestrian and bicycle lights can be found in the Travelyan report (1989). There was discharged recommendations for transformation combined crossing for pedestrians and cyclists. The recommendations of the 1989 lists the use of signal light, which will show a pictogram of pedestrian and cyclist. In the UK, describing the solution of traffic lights is called Toucan crossings, whose name is an acronym of two-can--cross. In 1993, an analysis film by Morgan (1993) to toucan crossing in order to understand users behavior of described solution. This report also illustrates an important aspect on the implementation of the new solution, which is public information shown in Figure 1. Studies show that the solution of combined junctions not adversely affect the safety and does not generate other undesirable effects not related to safety (eg the influence of pending a decision on secure crossing the road).

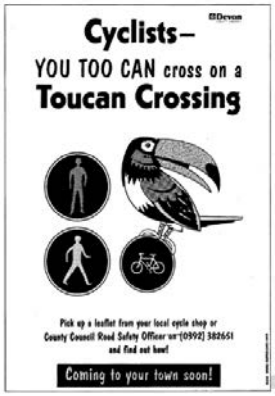


Fig. 1. An advertising campaign of toucan crossing in the UK.

Figure 2a shows the main signal light mounted at the crossing. In contrast, Figure 2b shows the auxiliary signal light with a button to trigger signal changes. The photos were taken from the report the Department for Transport in the UK (2015).

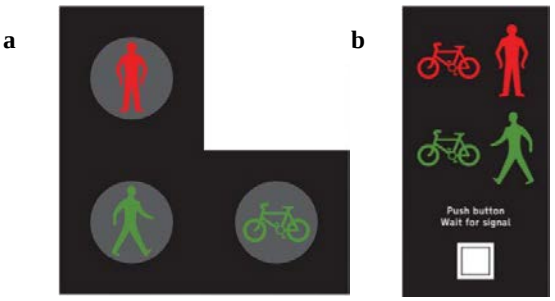


Fig. 2. (a) Toucan crossing signal light in the UK; (b) Toucan crossing signal light with a button excitation signal used in the UK.

The report released by the Department for Transport the Scottish Executive Welsh Assembly Government (2008) describes and presents the analysis of infrastructure solutions used for cycling in the UK. The authors point out that segregated roads for cyclists and pedestrians should have a common area before crossings of Toucan type. The lights should be also adjust to be visible to pedestrians and oncoming cyclists. Also in Germany are being used the toucan crossing lights, which were described in Forschungsgesellschaft für straßen- und Verkehrswesen (2010). Figure 3 shows a pictogram symbols used in Germany.

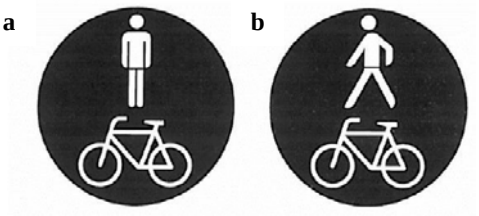


Fig. 3. (a) Toucan crossing light displaying the red signal used in Germany; (b) Toucan crossing light displaying the green signal used in Germany.

The current size of the pictograms printed on the dial of signal light in Poland and its location is given by the Minister of Infrastructure of 3 July 2003 on the detailed technical requirements for road signs and signals and road traffic safety equipment and conditions of their placement on the road. According to existing rules, it is permissible to combine the signals for pedestrians and cyclists on one traffic light in cases on grounds of local (co-location of passages and crossings). Applicable lights in Poland are shown in Figures 4–5.

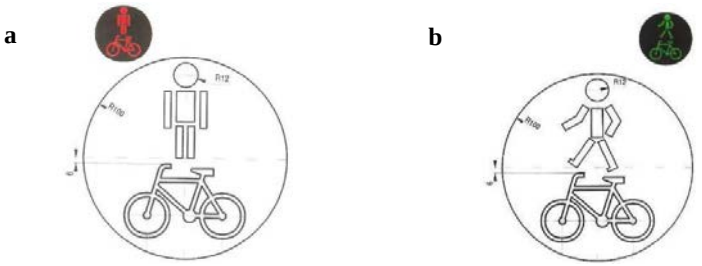


Fig. 4. (a) Toucan crossing light displaying the red signal used in Poland; (b) Toucan crossing light displaying the green signal used in Poland.

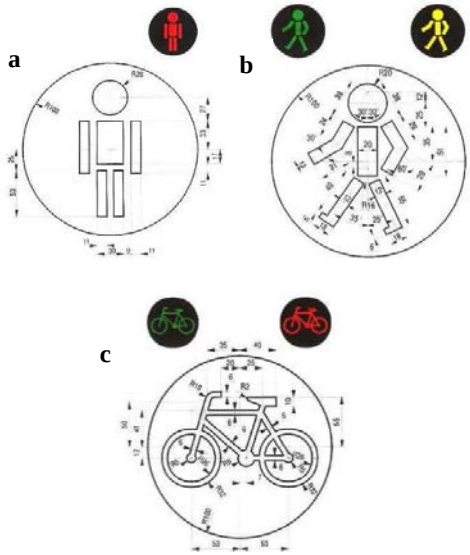


Fig. 5. (a) The pictogram of pedestrian during the red light used in Poland; (b) The pictogram of pedestrian during green and yellow light used in Poland; (c) The pictogram of bike during the green signal used in Poland.

Solution described allows the use of one supporting element, unlike to he method of sharing traffic lights on the pedestrian and cycling. Comparing the size of standard pictograms at lights in relation to pedestrian and bicycle, it can be seen significant differences in the size of the displayed objects. Symbol of pedestrian is reduced by forty percent in relation to pictograms at lights of pedestrian, and bicycle template about thirty percent compared to a standard traffic light. The preserved proportions are the same for a red signal and the green. Traffic lights for cyclists and pedestrians displays two small symbols, which under certain conditions can be read ambiguously.

In the literature are presented numerous studies on the operation of crossings, or the perception of signals transmitted through them, because infrastructure has a huge impact on the behavior and reactions of users. However, in the case of crossings for pedestrians and cyclists (toucan crossing) literature is not so rich. Examples of results and testing methods have been described by Ahuja and Chandra (2007), Bernhoft (2003), Hamed (2001) Sisiopiku and Akin (2003) Tanaboriboon and Jing (1994). The most common methods used are surveys and recording videos from the crossing. The first type of research allows for direct contact and for getting known the opinions eg on new solutions. Analysis of recorded videos allows the users to capture real actions of users. The main aim of the research in these articles was to examine the relationship between the behavior of pedestrians, and security at the crossing. Other aspects studied was to compare the behavior of a pedestrian at the toucan crossing and at the classic crossing.

## 2. Proving ground with the presentation of the research sample

In order to examine the factors influencing the perception of pedestrian and cycling signaling by of road traffic participants were carried out surveys and measurements of the traffic. All measurements were made between 07:00 and 19:00 held from 24.03.2015 r. (Tuesday) to 26.03.2015 r. (Thursday). The measurements were performed by two trained people. One person measured the intensity of pedestrian traffic, while the second conducted survey by the direct interview. Table 1 summarizes the data on characteristics of measurements, and Figure 6 shows photographs of conducted surveys on the perception of the traffic light for pedestrians and cyclists. Among conducted surveys 12% took place with cyclists, and 88% with pedestrians. However, the distribution of responses

to each group does not determine the results, since belonging to the test group of road users does not affect the examined factors of perception of walking-cycling signal light.

Table 1. Characteristics of measurements.

| Date | Day of the week | Measuring time [h] | Amount of questionnaires | Pedestrian/Cyclist traffic flow |
|---|---|---|---|---|
| 24.03.2015 | Tuesday | 12 | 130 | 1656 |
| | | 12 | 115 | 1160 |
| | | 12 | 61 | 287 |
| 25.03.2015 | Wednesday | 12 | 133 | 1259 |
| | | 12 | 126 | 1063 |
| | | 12 | 42 | 170 |
| 26.03.2015 | Thursday | 12 | 144 | 1170 |
| | | 12 | 80 | 933 |
| | | 12 | 136 | 261 |
| Σ | | 96 | 967 | 7959 |


Fig. 6. Photos from the conducted survey.

Figure 7 shows the distribution of the number of surveys in relation to the observed intensity of pedestrian and bicycle traffic throughout the measurement period for all measuring points.

On average, in one measurement interval were performed 20 surveys. The extreme was 32 and the least 11 in the interval measurement. Figure 8. shows the distribution of the age structure of subjects. Knowledge of the age structure is important because it can be strongly correlated with the answers contained in the questionnaires. Older people often have visual dysfunction, what might result in a misperception of the analyzed traffic light.

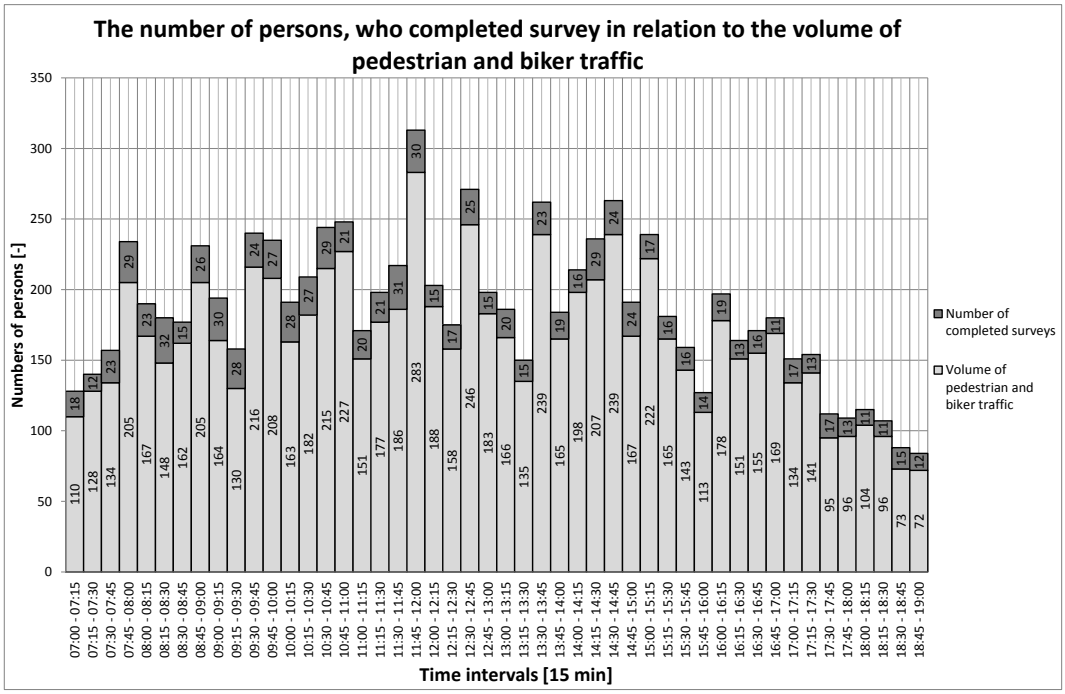


Fig. 7. Distribution of surveys in relation to the observed intensity of pedestrian and bicycle traffic.

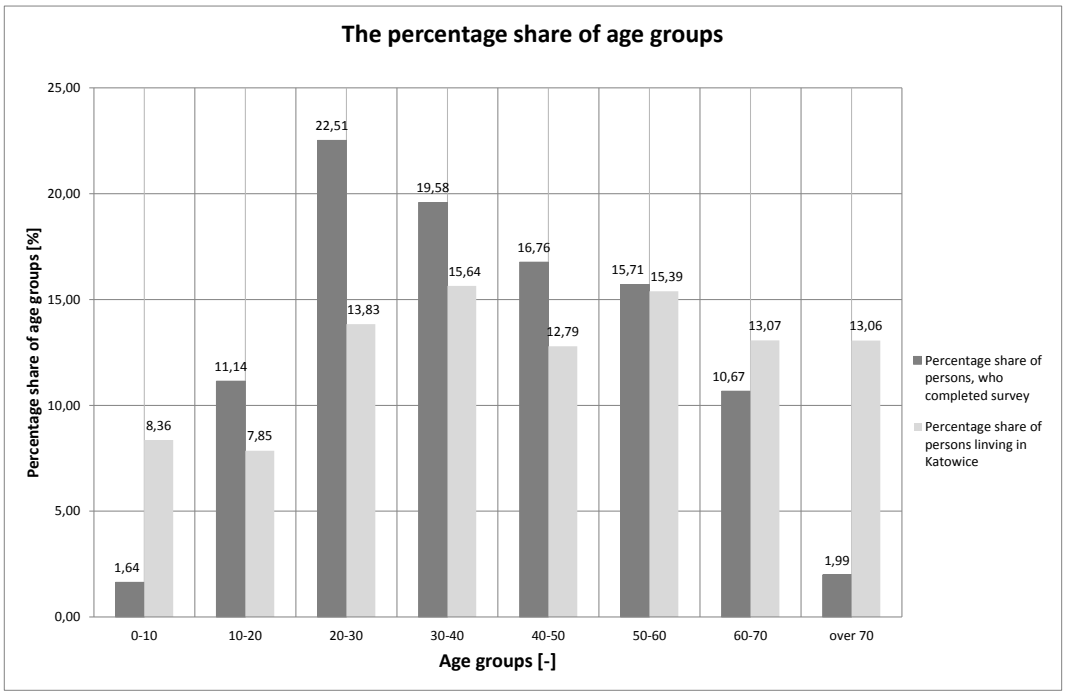


Fig. 8. Summary of the percentage of the age categories for people living in Poland and surveyed.

By analyzing the results presented in the chart located on Figure 8 can be seen the smallest number of people tested at the extremes of age, so further analysis omitted the survey carried out for these age groups. For the

youngest it is probably due to a lack of trust to strangers. While older people have limited mobility, which translates into a smaller number of surveys performed in this age group.

Figure 8 shows a comparison of the percentage prevalence of people in the age group for Katowice and conducted research. On the basis of the data presented in Figures 7 and 8 can be concluded that the sample on which the test was performed is diverse in age and gained responses from the questionnaires were distributed evenly over time.

## 3. Results of the survey

In order to examine the perception by users of the toucan crossing light, in the survey were asked the following question: “What symbol do you see/you on the traffic light?”. Figure 9 shows the distribution of responses along with the distribution by age groups.

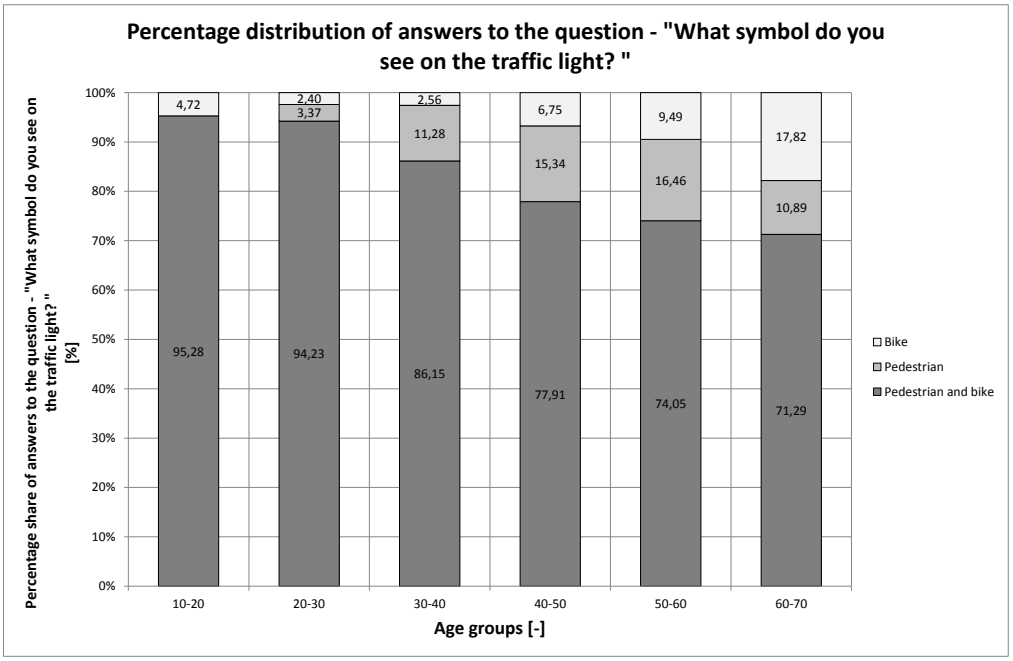


Fig. 9. Percentage distribution of answers to the question “What symbol do you see/you on the traffic light?”

When analyzing the chart shown in Figure 9 was observed that with increasing age of surveyed also increases the number of incorrect answers. In each age group of people above 30 years have been marked more than 13% of the responses, which indicated that at the traffic light is only the symbol of pedestrian or bicycle. Most incorrect indications, as much as 28.71%, was recorded in the age group of people who are between sixty and seventy years.

In the survey participants of traffic were also asked about their opinion on the size of the pictograms at the tested light chamber. Figure 10 shows the distribution of responses divided into age groups.

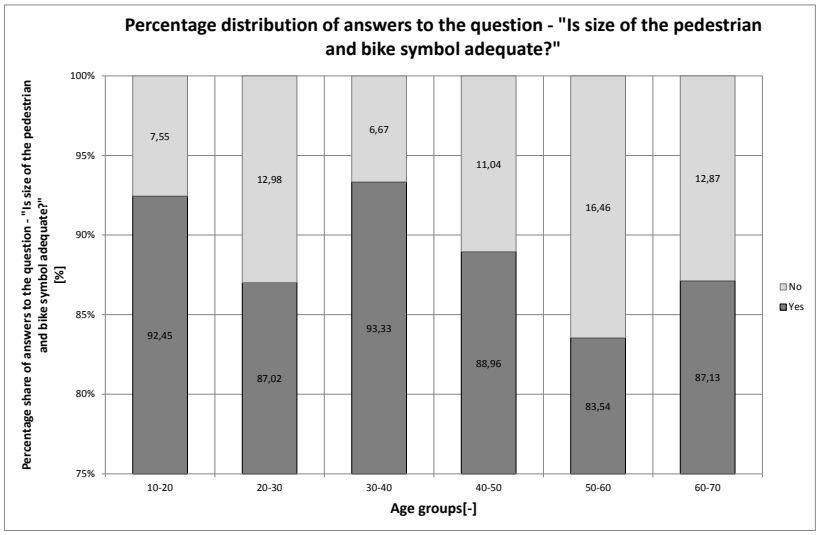


Fig. 10. Percentage distribution of answers to the question "Is the size of the pedestrian and bike symbol adequate?" – in age groups.

Analyzing the results divided into age categories of surveyed has been observed that in every interval on average, 11.2% of respondents believe that the size of the pictogram on the toucan crossing light is not suitable.

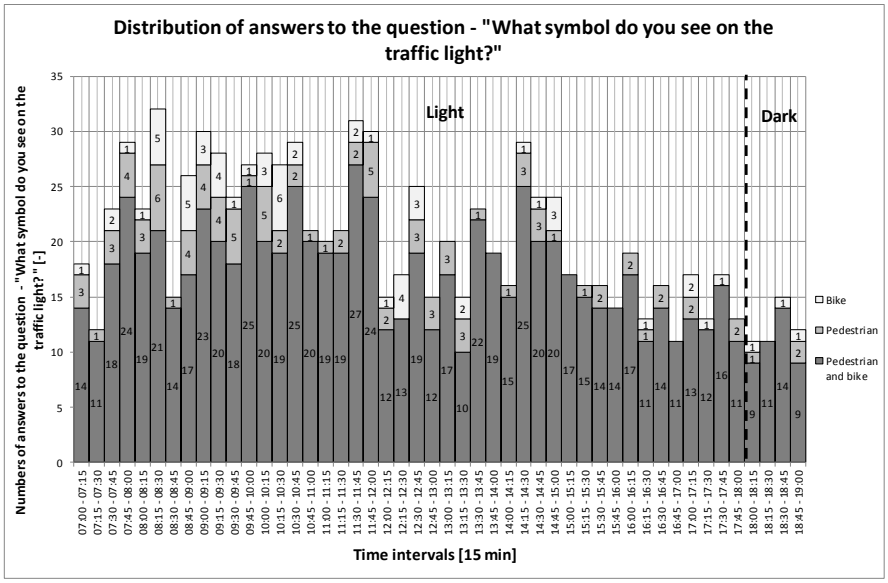


Fig. 11. Distribution of answers to the question – "What symbol do you see on the traffic light?"

Chart 11 shows the analysis of the response distribution in time, to the question "What symbol do you see on the traffic light?". The research was carried out both while the Sun was shining (from 7:00 until 18:00) and in the dark (from 18:00 to 19:00). However, due to the short duration of the studies in lower visibility conditions (at nightfall) there were no significant differences in the distribution of answers on the quality perception of the transmitted signals.

## 4. Conclusions

The results show that the quality of perception of the toucan crossing lights in elderly people is worse than in younger people, what may seem to be a natural phenomenon. Generally, with increasing age of respondents has been observed increasing problem with correct perception of the toucan crossing light. Approximately 11.2% of the respondents (regardless of age) believes that the size of the pictogram on the traffic light is insufficient. Structure of answers to question regarding recognition the symbol on the traffic light has a similar resolution, with an average response indicating the insufficient quality perception at the level of 16.8%.

Obtained results, according to the authors are not satisfactory – even though studies have been conducted in good weather conditions. It is worth, therefore, to take into consideration the change of the size of the traffic lights (and pictogram) to a larger or prohibit its use, for example, by replacing a separate signaling for pedestrians and cyclists. It is therefore necessary to consider the mandatory use of two lights – one for pedestrians and one for cyclists, because pictograms are larger and thus the quality of perception is better. Determination of quality perception of the signal light in bad weather conditions eg. with the rain and snow, as well as during the night will be the next stage of the research in this topic.

## References

Ahuja, S., Chandra, A, van Vuren, T., and Bell, M. G.H. 2007. Pedestrian behaviour and their perceptions around signalised traffic intersections (a comparative study across two cities, Birmingham UK and San Francisco, USA). Proceedings of WCTR 2007 Conference. USA.

Bernhoft, I.M., 2003. Risk perception and behaviour of elderly pedestrians and cyclists in cities in Denmark. Washington DC. USA.

Department for Transport, ROAD TRAFFIC: The traffic Signs Regulations and General Directions 2015, Statutory Instruments, UK, 2014.

Department for Transport Scottish Executive Welsh Assemly Government, Cycle Infrastructure Design, in Local Transport Note 2/80, 2008.

Forschungsgesellschaft für straßen- und Verkehrswesen, 2010.

Hamed, M.M. 2001. Analysis of Pedestrian Behaviour at Pedestrian Crossings. Safety Science, No. 38. p. 63–82.

Morgan, J. 1993. Toucan crossings for cyclists and pedestrians. Transport research laboratory 47.

Tanaboriboon,Y. and Jing,Q. 1994. Chinese Pedestrians and Their Walking Characteristics: Case Study in Beijing. Transportation Research Record 1441. P. 16–26.

Taylor, S., Halliday, M. 1997. Oedestrian's and cyclists' attitudes to Toucan Crossings. Transport research laboratory 277.

Travelyan, P., Ginger, M., 1989. Cyclists' use of pedestrian and cycle/pedestrian crossings. Transport and road research laboratory 173.

Rozporządzenie Ministra Infrastruktury z dnia 3 lipca 2003 r. w sprawie szczegółowych warunków technicznych dla znaków i sygnałów drogowych oraz urządzeń bezpieczeństwa ruchu drogowego i warunków ich umieszczania na drogach. 2003.

Sisiopiku, V.P., Akin, D. 2003. Pedestrian behaviour at and perceptions towards various pedestrian facilities: an examination based on observation and survey data. Transportation Research Part F. p. 249–274.